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ABSTRACT

This pocket folder of materials is designed to provide children aged 9 to 12 with an opportunity to explore and observe aquatic environments. The package includes a 4-H Leader's guide, member's guide, and supplementary materials. The leader's guide contains safety considerations, tips and techniques, and additional activities for getting started with the Water Worlds project. The member's guide describes activities for exploring the physical and biological environments of water worlds. The section on the physical environment gives background information, provides instructions for measuring water temperature, water depth, current speed, and turbidity and lists materials needed for activities. The section on the biological environment provides similar information for activities involving the observation and collection of aquatic plants and animals. The member's guide also contains: (1) a list of other activities; (2) reproducible water world activity records; and (3) references consisting of books, field guides, and activity sources. Supplementary materials in the folder include instructions for establishing freshwater acquariums and for creating saltwater aquariums in a jar, specialized aquariums, and breeding fish. An activity sheet explains the technique of Japanese fish printing. Water world activity record sheets are also enclosed. (KS)

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EXPERIENCE

4-H NATURAL RESOURCES

Water Worlds

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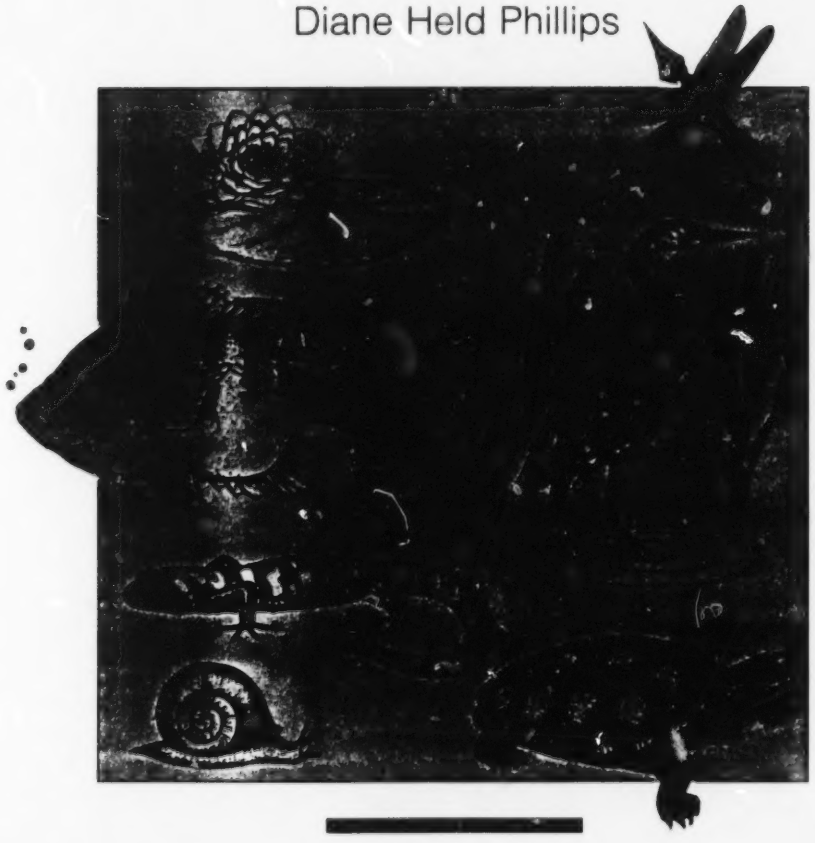

4-H Member's Guide
M-5-18
A Cornell Cooperative Extension Publication

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Illustrations by Steve Sierigk

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Cornell Cooperative Extension
Helping You Put Knowledge to Work

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This project is part of a series designed to introduce youth to a variety of natural resources subjects by involving them in activities that heighten their awareness of the natural world. Leaders, teachers, and camp counselors need no background in natural resources to work and learn with youth on these activities.

Introduction

Water is very important to our lives. It affects the way we live and how the world around us looks. All animals and plants need water to live, and many spend much or all of their lives in or around water. In fact, for some plants and animals, water is their whole world. In this project you will take a close look at water worlds and the plants and animals that are found in them.

Water worlds exist in many forms. Lakes, streams, ponds, rivers, and oceans are natural water worlds. Marshes and swamps are also natural water worlds, but they may have water for only part of the year. Human-made water worlds include fountains, reservoirs, ditches, and garden pools. Since all of these are made by water, they have some common characteristics. Yet each water world is different.

Every water world is set apart by its environment, or its living and nonliving surroundings. In this project we will look at a water world environment in three ways. First, we will examine its physical—or nonliving—features. These include water depth, temperature, and clarity (how clear the water is). Then we will look at the biological—or living—features of a water world. These include the plants and animals that live there. Last, while we work on these activities, we will consider how the physical and biological parts of a water world environment depend on each other. Do certain animals live only in shallow water or in deep water? What animals and plants live where water moves fast or where waves crash? What animals depend on other animals and plants for food or shelter? By looking at where and why different plants and animals live in a water world, we can learn more about them and understand how the physical and biological parts of a water world interact.

Physical Environment
Water Temperature

What Is the Temperature of the Water?

An important physical feature of water worlds is temperature. How warm or cold the water is determines how fast many of the plants and animals living there grow. Most plants and animals grow quickly in warm water and slowly when the water is cold. Most animals living in water worlds are cold-blooded (their body temperature is the same as the temperature of their surroundings), and they are less active when the water is cold. Temperature also affects how much oxygen the water can hold. Cold water has more oxygen than warm water.

Water usually is not the same temperature in all parts of a water world. Generally, the water becomes colder toward the bottom. Other things such as shade or currents and springs also may cause water temperatures to vary in different places.

Measuring Water Temperature

You can measure water temperature easily in shallow water or at the surface using a weather thermometer tied to a string. Place or hang the thermometer in the water for a few minutes and then read the temperature. To measure the temperature of deep water, you need to make a weighted thermometer.

Making a Weighted Thermometer

Materials Needed

- An empty soda can
- Sand or pebbles
- A short piece of wire or string (10 inches)
- A laboratory thermometer with an open loop at one end (must be able to read temperatures as low as 32°F, or 0°C)
- A can opener
- A long piece of sturdy string (at least 10 feet)

What to Do

1. Put some sand or pebbles into the empty soda can so it will sink.
2. Make holes in the top and side of the can with the can opener.
3. Pass the short piece of string or wire through the loop of the thermometer.
4. Place the thermometer in the can and, passing the short piece of string or wire through one set of holes, tie or wire it securely to the can.
5. Tie one end of the long string securely to the can, passing it through the other set of holes.

Using the Weighted Thermometer

To use the weighted thermometer, lower the can into deep water and let it remain there for five minutes. This will allow the temperature in the can to reach the same temperature as the water. Bring the can up quickly and read the thermometer, being sure the tip of the thermometer remains in the water in the can.

Measure the temperature in several different parts of a water world. Is there a pattern in temperature change as you measure at different depths? Do the temperatures of moving and still water differ? Does the time of day or the weather affect the water temperature? Once you have recorded temperatures in several areas, you can make a map of the temperatures of the water world. You can return to those same spots at different times of the year to see if the temperatures change with the seasons.

Weighted thermometer

Physical Environment
Water Depth

How Deep Is the Water?

The depth of water in a water world is important to the plants and animals that live there. As water gets deeper, several things happen. Generally, the deeper the water, the colder it will be. Cold water can hold more oxygen than warm water. This explains why fish that require a lot of oxygen move to deep water in the summer when surface water heats up. Also, less light energy is available in deep water for plant growth. All these factors influence the life found at different depths in a water world.

Measuring Water Depth

There are several easy ways to measure the approximate depth of water. If the water is shallow, you can use a yardstick to measure its depth. A long stick can be used with a yardstick or tape measure to measure slightly deeper water. Place the stick in the water straight down until it reaches the bottom. Pull the stick out and measure the height of the water mark on the stick. To measure the depth of deep water you will need a depth gauge.

Making a Depth Gauge

Materials Needed

- A long rope (at least 12 feet)
- A weight (brick, anchor, or plastic jug or can filled with sand or stones)
- Waterproof markers, 3 different colors
- A tape measure or yardstick

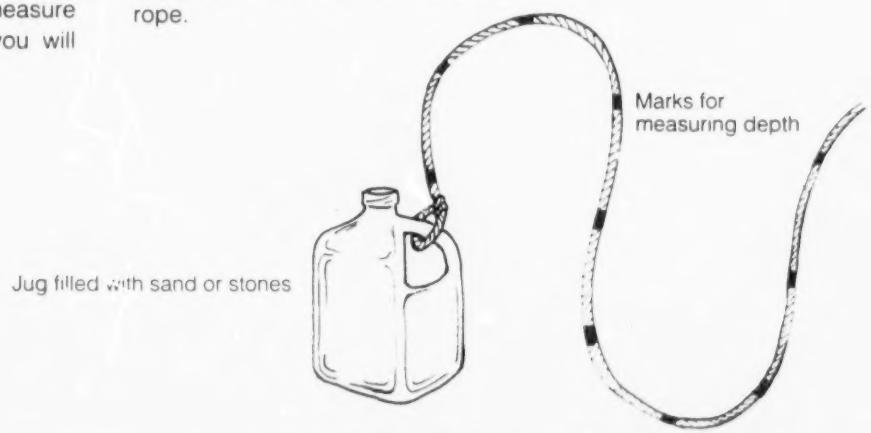
What to Do

1. Attach the rope to the weight.
2. With the weight on the ground, hold the rope straight up. Have a friend measure 1 foot from the ground and mark the point on the rope.
3. Create a color code for marking different lengths. For example, let a black mark = 1 foot, a blue mark = 5 feet, and a red mark = 10 feet; therefore 15 feet = 1 red mark and 1 blue mark; 20 feet = 2 red marks; and 25 feet = 2 red marks and one blue mark. Use a black mark to label each foot between 0, 5, 10, 15, 20, and 25 feet.
4. Using your color code and tape measure, mark the rest of the rope.

Using the Depth Gauge

To use the depth gauge, lower it into deep water until it rests on the bottom and the line slackens. Pull the line up gently to remove the slack. Determine the approximate depth of the water from the color marks on the rope. Record the depth in a notebook or on a map. (Note: You can measure temperature and depth at the same time by connecting a laboratory thermometer to your depth gauge.)

Use your depth gauge from a dock, pier, boat, bridge, or other place where you can get over the water. Measure depths in several different parts of a water world. After you have measurements from several areas, you can make a map of the water world. Knowing the depth can help you determine what plants and animals live there. It may even help you catch fish.



Depth gauge

Physical Environment
Current Speed

How Fast Is the Water Moving?

Not all water stands still. The water in rivers and streams is always moving, usually at different speeds in different places. This movement is called a current. Currents affect the plants and animals living in water worlds by shaping the bottom, carrying food into an area, and carrying wastes away. The speed of the current often determines what can live in a water world. By dropping an object in a stream and timing how long it takes to travel a certain distance, you can determine the speed of the current.

Measuring Current Speed

Materials Needed

- A stopwatch or watch with a second hand
- Several sticks large enough to be seen from a distance
- A pencil and paper to record results
- A tape measure
- Two people, one to keep time and one to drop the sticks and record the time

What to Do

1. Measure the distance between two points along a stream. The point upstream will be the start; the point downstream will be the finish.
2. Have one person drop a stick in the water several feet behind the starting point. When the center of the stick reaches the start, begin timing. When the center of the stick reaches the end point, stop timing. Record the time.
3. Repeat step 2 many times. Try timing a stick in different parts of the stream, such as along the bank and in the middle. Keep track of the times recorded for different parts of the stream.

Using Time and Distance to Calculate Current Speed

Now you know how long it took a stick to travel a certain distance. To figure out the speed of the current, divide the distance by the time.

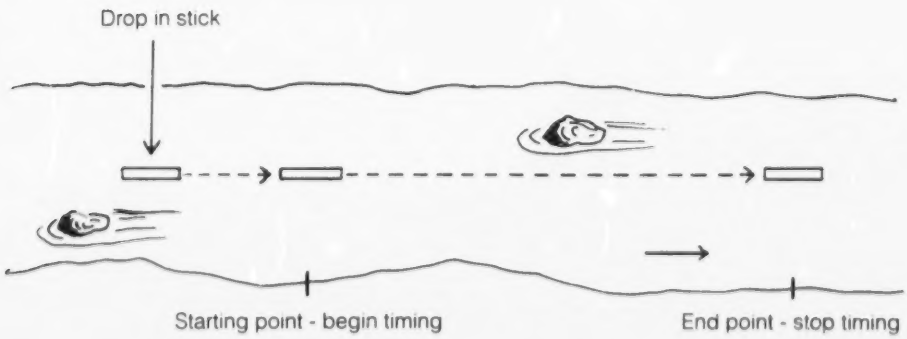
Example: A stick traveled 20 feet, from start to end, in 10 seconds.

Distance ÷ time = speed

20 feet ÷ 10 seconds =
2 feet/second

If a stick traveled 20 feet in 5 seconds, the speed of the current would be 20 feet ÷ 5 seconds = 4 feet/second.

Calculate the answers for the times and distances you recorded. Have your leader help you figure the values. Compare the speeds of the current in different parts of the stream. Were they different? Why? The speed of water in a stream is determined by many factors, including the type of bottom, the slope or downhill angle of the stream, and the depth and amount of water in the stream.



Physical Environment
Turbidity

How Clear Is the Water?

The water in some water worlds is very clear, and in others it is very murky. Water clarity is affected by many things, including the presence of silt (soil particles), plankton (microscopic plants and animals), and nutrients. Water that is not clear is said to be turbid. The murkier the water, the more turbid it is. Some water worlds are naturally turbid, and others have become that way because of pollution or other human activities.

Water clarity is important to life in water worlds. The particles that cause turbidity block sunlight and prevent it from reaching deep water. Plants cannot grow in deep, turbid water because enough light does not reach the bottom. Animals have difficulty seeing in turbid water, which makes it hard for them to find food and move around. Fish have trouble breathing if the particles in turbid water clog their gills.

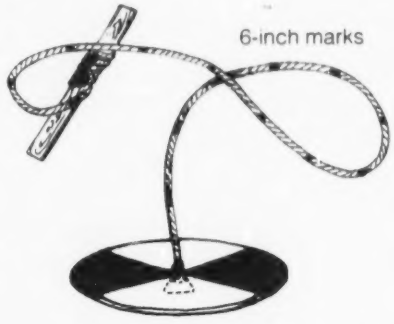
Measuring Turbidity

To determine how clear water is, you measure its turbidity. You can measure turbidity in a water world easily by using a device called a secchi (pronounced sek-ee) disk.

Making a Secchi Disk

Materials Needed

- A metal disk, 8- to 10-inch diameter (the top of a large tin can or a metal pie plate will work)
- A hand drill
- Black and white paint
- A long piece of heavy string or light rope (about 10 feet)
- One or more large lead weights (1 ounce or more)
- A stick or wooden dowel (about 1 foot long)
- A waterproof marker



Secchi disk

What to Do

1. With the help of an adult, drill in the center of the metal disk a hole large enough for the rope to pass through.
2. Divide the disk into quarters and paint alternating sections black and white.
3. Thread the rope through the hole in the disk and attach the weight(s) to the end of the rope on the unpainted side of the disk.
4. With the disk against the weight(s), tie a knot in the rope that is snug against the painted side of the disk.
5. Tie the free end of the rope to the stick or wooden dowel.
6. Using the marker, make a mark on the rope every 6 inches, beginning 6 inches above the disk.

Using the Secchi Disk

To use your secchi disk, hold on to the stick and the rope and lower the disk into the water until you no longer can see the painted surface. Using the marks on the rope, determine how deep the secchi disk is when you lose sight of the black and white pattern. This depth is your measure of turbidity.

Use your secchi disk from a dock, pier, boat, bridge, or other place where you can lower it into water without stirring up the bottom. Try measuring turbidity in several different parts of a water world. Compare these measurements to see if some areas differ from others. Where is the water most turbid? You can return to the water world in different seasons to see how turbidity changes during the year.

Biological Environment
Observing Plants and Animals

What Is Living in a Water World?

Water worlds contain a wide variety of life. Many water plants and animals are large and easy to see. Others are very small and are seen most easily through a microscope. The best way to learn about plants and animals in a water world is to watch them in their natural homes. Sometimes this can be done simply by looking into the water. At other times, glare, ripples, or waves make it hard to see below the surface. You can avoid these problems by using an observation window.

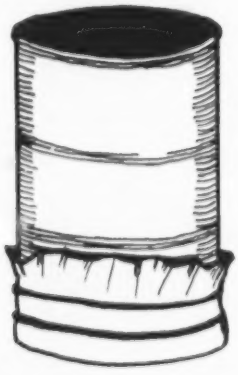
Making an Observation Window

Materials Needed

- An empty #10 can or plastic bleach bottle (the container should be stiff to prevent collapse or leakage from water pressure)
- A can opener
- Sharp scissors
- Black spray paint
- Clear plastic wrap
- Large rubber bands (2 or 3)

What to Do

1. Cut off the bottom of the can (or top and bottom of the bottle) so you have a cylinder.
2. Paint the inside of the cylinder black.
3. Stretch plastic wrap over one end of the cylinder and secure it tightly with the rubber bands.



Observation window

Using the Observation Window

To use the observation window, put on old sneakers and wade into the shallow, clear water of a water world. *(Do this only where you know the water is shallow and when there is an adult present).* With the end covered with plastic wrap down, hold the observation window halfway into the water. Lean over, putting your face close to the top of the cylinder. If you move slowly, you should see a variety of plants and animals. Watch for animals swimming by, walking along the bottom, or sitting still. Many will blend in with their surroundings, so you must look carefully. You can record your observations and perhaps collect some samples to look at more closely. If you collect any plants or animals, be sure to handle them gently and return them to their water world when you are finished studying them.

Biological Environment

Collecting Plants and Animals

How Can You Study Life in a Water World?

One way to get a close view of plants and animals that live in a water world is to catch or collect them. When collecting, remember that you are a visitor to the water world and be careful not to damage the surroundings or injure anything living there. If you take some plants or animals to study, be sure to return them to their water world when you are done.

Making Collecting Equipment

You will need equipment to collect water animals and plants. You can make several devices yourself.

A Dip Net

Materials Needed

- A wire coat hanger or similar piece of wire
- Waterproof tape
- A wooden or aluminum pole
- An old nylon stocking or a piece of mesh netting or burlap
- A needle and thread

What to Do

1. Bend the wire into an open circle.
2. Use the tape to attach the two ends of the wire circle to the pole.
3. Sew the stocking or net material to the wire to form a net.

Dip net

Using the Dip Net

The dip net can be used to collect plants and animals located beyond your reach in a water world. Use a slow, gentle scooping motion for the best results. Once you have netted something, place it in a light-colored container with some water for easier observation.

A Seine

Materials Needed

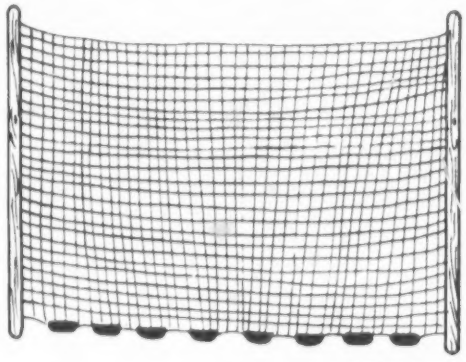
- A piece of netting or screening, 2 feet x 2 feet
- Two sturdy sticks or wooden poles, about 30 inches long
- A staple gun or string
- Eight one-ounce fishing weights

What to Do

1. Connect opposite ends of the netting to each pole with staples or string; make sure the bottom of the netting is even with the bottom of the poles.
2. Attach the weights a few inches apart along the bottom of the netting.

Using the Seine

To use the seine, hold the two poles apart and upright so the net is open but not tightly stretched. With the poles upright, drag the seine through the water; be careful to keep the weighted edge of the net on the bottom so animals cannot escape underneath the seine. Work the net back to the water's edge and lift the net and your catch out of the water. Transfer your catch to a container of water for observation.



Seine

A Bottom Sampler

Materials Needed

- A piece of burlap or heavy netting
- A needle and heavy thread
- A metal-tined garden rake
- String or fishing line (about 3 feet)

What to Do

1. Sew the burlap or netting into a bag with an opening that just fits over the head of the rake.
2. Using string or fishing line, attach the bag opening to the back of the rake head.

Using the Bottom Sampler

This sampler works best on mud, sand, or gravel bottoms. Drag the tines of the rake across the bottom to stir up any animals living there. The animals are captured in the bag hanging behind the rake. Try to catch as little mud or sand in the net as possible. Transfer your catch to a container of water for easier observation.

Use the collecting equipment you have made to gather plants and animals from various places in a water world. Compare what you collect from one place using one kind of equipment with what you collect from another with a different device. Can the dip net gather the same plants and animals collected by the bottom sampler? Can you find in still or slowly moving water the same animals that you found in faster currents? Look for other relationships between plants and animals and their environment as you explore life in a water world.

Bottom sampler

Other Activities

The following activities are suggested to help you discover and study water worlds further.

1. Make an aquarium for plants and animals you collect from a water world. The Leader's Guide for this project has details on fresh and saltwater aquariums.

2. Photograph a local water world during each season. Put together a picture story showing how the area is used by people and other animals.

3. Visit your community water treatment plant. Find out the source of the water and the process used to clean it. Are chemicals added during treatment? Why?

4. Using a map, list all the water worlds in your area. Put them into categories, such as flowing water, freshwater, and human made. Which water world is closest to your home?

5. Learn to identify aquatic insects. Make a collection of several different aquatic insects by preserving them in small, labeled jars of alcohol.

6. Make a shell collection. Collect shells along a beach or shore and clean and dry them. Use a field guide to identify the animals whose shells you collected.

7. Visit a nearby reservoir and dam. Find out how the dam operates and why it was built. How does the reservoir above the dam differ from the river or stream below the dam?

8. Take a walk along a beach, lake shore, or river bank. Count how many animals or signs of animals you see. Look for shells, tracks, feathers, and animals in and around the water's edge.

Water World Activity Record

Location: _____ Date: _____

Physical:

(Fill in the physical characteristics you observed in this water world.)

Temperature:	At surface _____	At bottom _____	Other _____	Average _____
Depth:	Shallowest _____	Deepest _____	Other _____	Average _____
Current Speed:	Slowest _____	Fastest _____	Other _____	Average _____
Turbidity Measurements:	Lowest _____	Highest _____	Other _____	Average _____

Biological:

(Fill in your observations of the living things in this water world.)

What plants did you see in or near the water?

What animals or signs of animals did you see?

What were the animals doing?

Other observations:

What was most interesting about this water world?

Resources and References

Books and Field Guides

Buck, M. W. *In Ponds and Streams.* New York: Abingdon Press, 1955. (A clearly written description of freshwater plants and animals, their life histories, and their adaptations.)

Guide to Freshwater Fishes of New York. Cornell Cooperative Extension, Miscellaneous Bulletin 108. (A comprehensive guide to New York's freshwater fishes, including keys to families and species.)

Hausman, L. A. *Beginner's Guide to Seashore Life.* New York: G. P. Putman's Sons, 1949. (A simple, yet extensive, coverage of animal life at the seashore.)

Klots, E. B. *The New Field Book of Freshwater Life.* New York: G. P. Putnam's Sons, 1966. (An in-depth guide to the plants and animals of freshwater ecosystems.)

Reid, G. K. and H. S. Zim. *Pond Life.* New York: Golden Press, 1967. (A beginner's handbook of plants and animals found in and around freshwater ponds and streams.)

Urson, M. J. *Life in and around Freshwater Wetlands.* New York: Thomas Y. Crowell, 1975. (A brief, illustrated guide to common plant and animal life of marshlike fresnwater environments.)

Activity Sources

Exploring Freshwater Fisheries. Cornell Cooperative Extension, 4-H Leader's Guide L-5-7. (A collection of activities involving fish identification, observation, and collection and associated activities.)

Jaeger, R. *Marine and Aquatic Field Trip Guide to New York State.* New York State Sea Grant Institute. (Describes possible field trips to sites in New York City and Suffolk, Nassau, Westchester, Rockland, Erie, and Niagara counties and related activities.)

Let's Go Fishing. Cornell Cooperative Extension, 4-H Leader's Guide L-5-6. (A five-part lesson on fish identification and fishing basics.)

Let's Go Ice Fishing. Cornell Cooperative Extension, 4-H Leader's Guide L-5-15. (An introduction to ice fishing equipment, safety, and techniques.)

Wading into Wetlands. Produced by the National Wildlife Federation as an issue of *NatureScope.* (An array of information and activities involving fresh and saltwater wetlands. Order no. 75025.)

The U.S. Fish and Wildlife Service has developed activity guides on estuaries, freshwater marshes, and tidal marshes. Most are suitable for youth in primary through secondary grades. For information, write the National Institute for Urban Wildlife, 10921 Trotting Ridge Way, Columbia, MD 21044.

Natural Resources Youth Development Program

Environmental Awareness and Issues

Environmental Awareness

Environmental Awareness: Wildlife

Nature Trails: Guides to Environmental Understanding

(Starting a Small Business in Natural Resources)

(Water Quality)

Fisheries and Aquatic Education

Let's Go Fishing

Basic Fly Tying

Exploring Freshwater Fisheries

Let's Go Ice Fishing

If Fish Could Talk

The Great Garbage Chase

Sands, Oceans, and Sailors

Aquatic Activities for Youth

Water Worlds

(Aquatic Education Manual)

Forestry

Know Your Trees

4-H Wood Sample Collection

What's a Tree to Me

Trees from Seeds

Tree Planting

Backyard Maple Sirup

Understanding Forest Ecosystems

Firewood: From Woodlot to Woodpile

Forestry A: Trees

Forestry B: Forests

Forestry C: Forestry

Northeast 4-H Forestry Project

(Introduction to Forestry)

Wildlife

Bird Study: An Introduction to Ornithology for Youth

Bluebirds in New York (currently being revised)

Nest Boxes for Wood Ducks

NYS DEC Pheasant Rearing Guide

Understanding Birds of Prey

Southwest 4-H Wildlife Projects

Wildlife Habitat Enhancement

Trapping Furbearers DEC Student Manual

Shooting Sports

Birds in Your Backyard

(Introduction to Wildlife Principles)

(Urban/Suburban Wildlife Habitat Improvement)

Note: *Projects in parentheses are being developed.*

Program Philosophy

The 4-H Natural Resources Program provides educational programs for adult volunteers and youth using the research and knowledge of Cornell faculty and students in the Department of Natural Resources. The educational programs can be divided into three categories: (1) Natural Resources Awareness projects encourage youth to make personal discoveries about their local environment. (2) Ecology and Management of Natural Resources projects promote understanding of the scientific principles involved in managing our natural resources. (3) Environmental Issues projects train youth to become better decision makers about issues relating to environmental problems.

Program Sequence

No rigid sequence of projects is built into the program, but a logical flow from awareness through understanding to involvement and leadership exists. Natural Resources Awareness level projects provide the foundation for the more advanced Ecology and Management of Natural Resources and Environmental Issues projects. Advanced 4-Hers with an interest in natural resources are encouraged to attend the annual Natural Resources Youth Action Program at the Arnot Forest, during which they receive intensive training in natural resources subject matter from Cornell faculty and students.

EXPERIENCE

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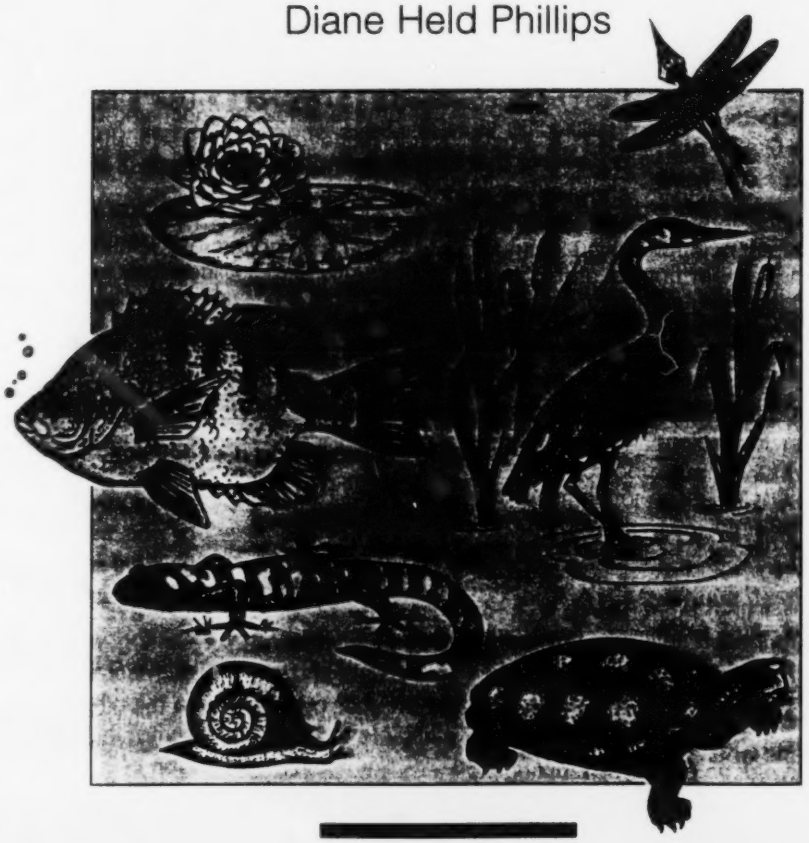

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This project is part of a series designed to introduce youth to a variety of natural resources subjects by involving them in activities that heighten their awareness of the natural world. Leaders, teachers, and camp counselors need no background in natural resources to work and learn with youth on these activities.

Introduction

This project is designed to provide young people with the opportunity to explore and observe aquatic environments. The project is written at an introductory level for youth aged nine to twelve. The leader is not expected to be an expert in aquatic science or to have prior knowledge of aquatic environments. Through participation in the activities described in the Member's Guide, both adult leaders and youth will have opportunities to learn together about the physical and biological features of the worlds of water.

This Leader's Guide, by providing safety considerations and tips and techniques, will help you get started on the Water Worlds project. For those groups that wish to explore aquatic environments further, suggestions for additional activities are included. You will find in your leader's folder a copy of the Member's Guide, several supplemental project bulletins, and extra Water Worlds Activity Records for members. Not included are pictures and descriptions of the plants and animals that you might find when you investigate various water environments. The use of simple field guides for identifying plants and animals is strongly recommended, for they will add greatly to the learning experience.

Where to Begin

In this project, youth can examine a variety of aquatic environments, or water worlds, including ponds, streams, rivers, lakes, puddles, salt marshes, or an ocean. Even human-made aquatic environments such as fountains, dams, and ditches are suitable for study.

Don't be discouraged if you cannot identify fish, insects, plants, or other organisms that members find. Just showing you are interested and curious about the natural world will encourage them to explore and discover. Use the field guides listed in the resource section of the Member's Guide to find out the names and characteristics of the specimens your group finds.

As an introduction to this project, you can spark your group's interest in water environments in several ways. Lead them on a field trip to an aquarium, fish hatchery, or nature center. Bring a turtle, crayfish, or other aquatic animal to a club meeting. Even pictures of the plants and animals you may find on your outdoor adventures will stimulate their curiosity.

Safety

Young people are naturally curious about water, but they may be unaware of its potential dangers. Below are a few safety precautions to consider when leading a group to explore aquatic environments:

- Be familiar with a site before taking a group to it. Point out hazardous areas, local rules, and boundaries.
- Have youth walk carefully and slowly. They will be more alert to their surroundings and will observe more. This precaution is especially important where slippery rocks and currents exist. Also encourage youth to walk where they will not damage plant or animal life.
- Use a buddy system or work in small groups so you can keep track of everyone.
- If a boat is used to take depth or temperature readings, be sure you and your group all wear U.S. Coast Guard–approved life preservers and observe safe boating procedures.
- Be aware of the potential dangers in aquatic environments. Some examples are currents and slippery rocks in streams and stinging or poisonous plants, insects, and animals around ponds, lakes, and other standing waters.
- Getting wet while performing the activities in cold weather can lead to hypothermia. Be aware of the symptoms. (For a good discussion of hypothermia, see the 4-H project bulletin Let's Go Ice Fishing.)

Tips and Techniques

- Know your site. If it is on private lands, be sure to have permission and know the rules or restrictions for its use.
- Set boundaries for the group at the study site. (This will help you keep track of the group.)
- Respect the rights of anyone fishing or using the area.
- Approach the site carefully so that animals are not scared away and plants are not trampled.
- Have group members make observations about the site before they disturb the water.
- Explain and demonstrate the use of collecting equipment.
- Keep collection and observation pans in a shaded area. Water in shallow containers in the sun can become so hot that the specimens die.
- Demonstrate or explain the safe handling of water plants and animals. Be sure to tell your group what specimens not to collect or touch (for example, jellyfish and nettles).
- Try not to collect more than you need. Limit the collection time or the number of specimens allowed. Share collections among group members.
- Return the specimens to their water world when you are finished discussing and observing them.
- Transport plants and animals collected to make an aquarium in plenty of water (taken from the same site). Before collecting plants and animals, ask your local state conservation agency if any species in your area are legally protected.

Additional Activities

- Have members of your group list all the uses of water they can think of. Have them count the number of times they use water in a day, including eating and drinking.
- Starting with this project, 4-Hers can make a listing of all the aquatic plants and animals they see. Call this a Life List. Help them use field guides to identify or confirm their sightings.
- Visit a water environment at night to see what animals are active. Cover flashlight lenses with red cellophane or balloons. The red light won't scare away the animals.
- Invite a marine biologist, fish hatchery operator, conservation officer, or other person involved with aquatic resources to speak to your group. A discussion of careers in aquatic sciences may interest older youth.
- Even human-made water worlds such as fountains, garden ponds, pools, and drainage ditches can be a haven for aquatic life. Have your group compare human-made water environments with naturally occurring ones.
- Take your club on a fishing trip. When group members understand the relationships between animals, plants, and the physical environment, they may be able to predict where fish live. See the list of references and resources in the Member's Guide for 4-H projects related to fishing.

Use the supplemental projects included in the leader's folder if time is available and members show interest. The supplements include

Entomology and Water

Fish Aquariums

A Saltwater World in a Jar

Japanese Fish Printing

Making a Freshwater Aquarium

These projects are more advanced than the activities in the Member's Guide. Adult supervision or guidance is advised to ensure a positive learning experience.

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Illustrations by Steve Sierigk

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Cornell Cooperative Extension
Helping You Put Knowledge to Work

9/88 3M MS E8804080401

Water World Activity Record

Location: _____ Date: _____

Physical:

(Fill in the physical characteristics you observed in this water world.)

Temperature:	At surface _____	At bottom _____	Other _____	Average _____
Depth:	Shallowest _____	Deepest _____	Other _____	Average _____
Current Speed:	Slowest _____	Fastest _____	Other _____	Average _____
Turbidity Measurements:	Lowest _____	Highest _____	Other _____	Average _____

Biological:

(Fill in your observations of the living things in this water world.)

What plants did you see in or near the water?

What animals or signs of animals did you see?

What were the animals doing?

Other observations:

What was most interesting about this water world?

9/88 30M MS E88040804

Water World Activity Record

Location: _____ Date: _____

Physical:

(Fill in the physical characteristics you observed in this water world.)

Temperature:	At surface _____	At bottom _____	Other _____	Average _____
Depth:	Shallowest _____	Deepest _____	Other _____	Average _____
Current Speed:	Slowest _____	Fastest _____	Other _____	Average _____
Turbidity Measurements:	Lowest _____	Highest _____	Other _____	Average _____

Biological:

(Fill in your observations of the living things in this water world.)

What plants did you see in or near the water?

What animals or signs of animals did you see?

What were the animals doing?

Other observations:

What was most interesting about this water world?

Japanese Fish Printing (*Gyotaku*)

Objectives

To help youth

1. gain a greater appreciation for the physical details of a fish by practicing an art where attention to such details is essential
2. acquire skill in an interesting art
3. enjoy the study of fishes

Materials and Equipment

1. Fresh fish (start with a member of the sunfish family)
2. Soap and water
3. Newspaper
4. Plastic modeling clay
5. Pins
6. Water-base ink (linoleum block ink preferable)
7. A stiff ½" brush
8. A very small brush
9. Rice paper, newsprint, or other moisture-tolerant paper (because rice paper is expensive, you might prefer to start with newsprint)

Teaching Aids

Guide to Freshwater Fishes of New York (Cornell Miscellaneous Bulletin 108)

From:
Exploring Freshwater Fisheries

Japanese Fish Printing

The technique of Japanese fish printing, known as *gyotaku* (pronounced ghio-ta-koo), has been used in Japan for over 100 years to record catches of sportfish and to gain information on fish biology. These prints have even been used to study how the physiology of a fish is related to its surface area.

The art of *gyotaku* is a good way to gain an understanding and appreciation of the beauty and great variety of fish characteristics. You can also use this technique for making prints of shells, rocks, flowers, and other items.

Fish prints are of less value than photos for fish identification, but they can be done by anyone and do not require sophisticated or expensive equipment. They are an attractive art form and add yet another dimension to an interesting exhibit or display.

Before you make a print, identify the fish. What are the distinguishing characteristics of the fish? Study the life history of the fish. Where and how was it caught?

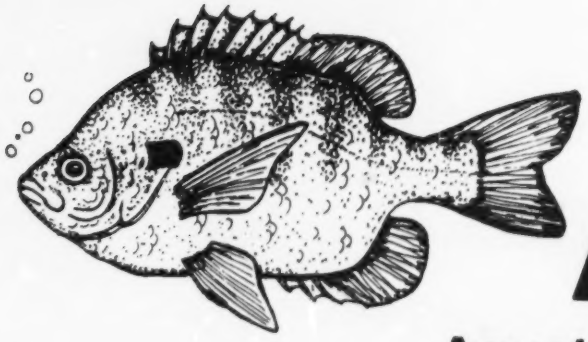
The back of your prints should bear the same field label as other materials relating to the particular fish. In this way you can make a complete set of both technical materials for and abstract representations of a specimen.

Your fish prints can be framed for a professional appearance or they can be covered with less expensive clear plastic food wrap. The latter method makes storage easier but offers less protection, especially if they are to be used frequently in displays.

Making Japanese Fish Prints

To make your fish prints, simply follow these six easy steps:

1. Use soap and water to clean the outside of the fish as completely as possible. The cleaner the fish, the better the print. Dry the fish well.
2. Place the fish on a table covered with newspapers. Spread the fins out over some clay and pin them in this position. Continue to dry the fish.
3. Brush on a thin, even coat of ink. Leave the eye blank, unless you prefer to fill it in.
4. Place a piece of newsprint or rice paper over the top of the fish.
5. Carefully lay the paper over the entire fish. Use your fingers to gently press the paper over the surface of the fish, being careful not to move the paper too much since this may cause double prints. Then remove the paper, and you have a fish print.
6. Use a small brush to paint the eye.



Fish Aquariums

Aquatic Activities for Youth — 1

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Establishing an aquarium can be an educational, interesting step into a new world. Fish are beautiful creatures, and with proper planning, they can be inexpensive, easy, and soothing to work with. Without planning, they can be messy, expensive, and anything but soothing. If your aquarium is set up properly, you won't need to do much to operate it efficiently. Your fish will be dependent on you, and you will have to feed them and keep their tank clean. Your project will show your work, careful or careless. It will give you the chance to observe actions and behavior. Your tank will become a fascinating showcase, beautiful and scientifically balanced.

You will find yourself asking many questions about these interesting creatures. Most of your answers will come from nearby sources. Here are some examples:

- Talk to friends and other people who have fish. They may be able to give you ideas from their own experience.
- The pet store where you bought your fish and equipment should have helpful information.
- In section 597.074 of your public library, you will find books on aquariums and fish. Librarians will also help you find what you need. Keep a list of the most useful books (title, author, publisher, and date) to study later or to help others start their projects.
- Look up magazines on aquarium science in the library.
- Some towns have aquarium clubs or societies you may want to join.

Project activities are divided by equipment and experience. You may use any you wish, but you should consider your experience and the time you have to work.

Outline of Projects

Part 1. The Balanced Aquarium
Equipment
- Simple bowl (beginner)
- Specialized tank (advanced)

Environment
- Plants, rocks, sand, water, and filters

Foods. For a successful aquarium more care is needed than just dumping food in each day.

The fish
- Selection
- Identification and classification

Part 2. Breeding
Types of fish
Traits
Diseases, pests, and problems

Part 3. Specialized aquariums (salt, fresh water, and specific habitats)

Keep a record book of whatever you do. Record costs, trials, and tribulations. Observe what goes on; then make some observations. These observations should lead to more questions. Learn to rely on another person or a good reference book when your own experience fails you.

Part 1. The Balanced Aquarium

Equipment

Let's think about the "home" you are preparing for your fish. Let the water in the tank "season" one or two days before putting the fish in. This time allows dissolved chemicals (chlorine and sulfur) to settle in the water, bacteria to break down detergents, plants to establish roots, and rock dust to settle and leave the water sparkling clean.

Here is a list of things you'll need for your fish-in-a-bowl project:

salt (noniodized)	gravel
nylon net or cover	plants
siphon	snails
thermometer	food
net	

For an aquarium, you'll also need to purchase a light, pump, and filter. Bulky items that need to be stored can be divided among your friends who have fish.

The size of your water container controls the number of fish you may keep in two ways: it limits the amount of water, and it limits the surface area. Fish need oxygen just as people do, but their oxygen comes from water, not air. Putting too many fish in a tank is like putting too many people in a room. Too little surface area is like shutting all the doors and windows tight.

If you are using a bowl, fill it to the widest point, and allow at least 2 inches above the water line to keep fish from jumping out.

If you are using a large tank, fill it to within 3 inches of the top. The 3 inches allow for 2 inches of space at the top and 1 inch of gravel on the bottom. Here are some examples of how many fish your aquarium might hold. A gallon-size jar holds six to eight neon tetras, which are a small, slender fish. Two pairs of fish that altogether measure 1 inch in length require a gallon of water. More fish will require the aid of a pump and filter. A 5-gallon tank holds six pairs of fish, plants, and other animals. Labyrinth fishes, which swallow air from the surface, can take more crowding. But male Siamese fighting fish are always kept alone in quart jars since they kill one another if they are in the same container. It is best to allow fish plenty of elbow room until you have gained experience. Remember, fish grow and multiply.

To sterilize your tank and check for leaks, first wash the bowl and any accessories such as castles or marbles. Put the accessories into the bowl and fill it to the top with hot water. Add as much salt as will dissolve. Let the water set for about 1 hour. If you have a tank, dip or siphon off the water to prevent springing the sides. Rinse and add clean seasoned water, and you are ready to set up for your fish.

A small bag of colored gravel will cover the bottom of two to six 1-gallon jars. Solid-colored gravel is better than multi-colored because you can spot dirt and uneaten food more easily. Use care in selecting rocks for the bottom of your tank. Many rocks are limestone and will make the water alkaline. Some blue and green rocks contain poisonous compounds. Marbles are safer. Be sure that any decorations are colorfast and insoluble.

Net. Sometimes people handle fish with their hands, but the hands must be wet before handling the fish. It is best not to handle fish with your hands. Buy or make a small net.

Cover. A nylon net cover will keep hands, cats' paws, and foreign objects out. A half-yard will do for several people. A wad of extra net makes a fine cleaning cloth, and a narrow piece can be pulled through dirty tubing with a piece of fine wire.

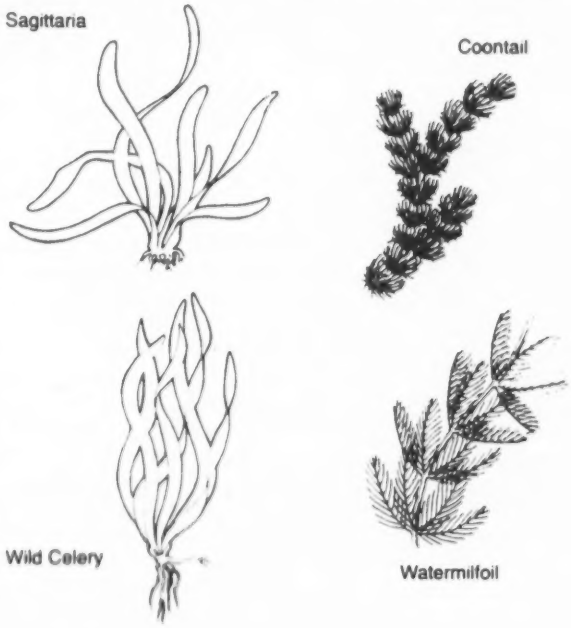
A box of plain, noniodized table salt is good for cleaning your equipment. **Never use detergent!** It can harm fish. Salt sprinkled on a clean cloth or wad of nylon net does an excellent job. Sick fish will sometimes recover in a solution of 2 quarts of seasoned water with 1 teaspoon of plain salt added. Put them in this solution for one-half hour each day until they seem better. To get rid of food particles and algae growth, rinse plants in the same solution when you clean the tank. Finish by rinsing them in clear tap water.

Thermometer. An indoor or outdoor thermometer will let you check water temperature when you change or add water. You may want to get a small aquarium thermometer to keep a constant check.

Environment

Depending upon the kinds of fishes you raise, the temperature of the water can be critical. Sudden temperature fluctuations may easily harm or kill your fish. If you are raising tropical fish, the temperature should be kept between 70° and 85°F., the optimum temperature being about 75°. Don't put tropical fish in water below 75°F. Careful monitoring of temperature is not as important for goldfish. They may live in water from 50°–75°F.

Plants. Plants increase the available oxygen in the water. Choose healthy plants with good color, a clean odor, and no slime. Rooted plants will need 1 to 2 inches of gravel. Slant the gravel so it is deepest at the back, and the dirt will collect at the front where it is easily removed. Plants can then be placed where gravel is deepest, to provide a background. Do not crowd plants because they take up space and get food caught on their leaves. If plants are placed on the side with the most light, baby livebearers will swim into them for protection. A small bunch of floating water plants will be enough for two to four bowls. Although several plants can be used, the hardiest are *Anacharis, Cabomba,* and *Vallisneria.*



Siphon. Plastic tubing for a simple siphon can be quite inexpensive if you buy plastic rope; if you want a suction attachment, it will cost more. Siphon up to one-third of the water from the bottom of the tank once a week. If you replace it with seasoned water, you will not have to change the whole tank unless you overfeed. For the tubing to work, it must be full of water. Fill it at the sink or by slowly lowering it into the tank. The end from which the old water exits must be lower than the intake end, which must be under water at all times. To move the siphon, pinch the tubing by folding it sharply.

If the siphon is working properly, dirt will be quickly sucked into the tube. Extend your finger below the intake end to guide the tube and stir up the dirt, especially if your gravel is fine enough to be picked up. Keep the tube slightly above the bottom. If gravel or a snail is pulled into the end, it will often drop free if the tubing is pinched. If it gets into the tubing and stops the flow, you may be able to flush it out by raising the intake end or by using the faucet. If this does not work, hold one end of the tube with one hand, and squeeze the rock or snail out of the tube with the other hand.

Snails. Snails can be large or small and are relatively inexpensive. You may find some on the plants you buy. Snails are helpful because they eat the food the fish leave and remove algae that forms on the sides of the tank. Baby snails look and feel like a fine grain of sand but grow quickly. They will be a nuisance unless you control the number in your aquarium. Snail eggs should be allowed only in large tanks. For large tanks, large snails are good because they do not eat plants and do not reproduce rapidly.

Use two small snails per gallon of water. Have no more than three large snails in a 5-gallon tank.

How to Fill Your Tank (one method)

1. Assemble the materials one or two days before getting the fish.
2. Put gravel in a pan or large strainer, and run tap water over it until the water runs clear. All gravels have some dust. Even after the gravel has been washed, dust may cloud the water until it settles.
3. Place the gravel in the bottom of the tank. Put more gravel in the back than in the front. This will bring dirt to the front for siphoning and allow deeper gravel for background planting. In round bowls with floating plants, the gravel should cover the bottom evenly.
4. When filling the tank, put a piece of paper or a saucer on the bottom of the tank, and pour the water onto it. This technique will lessen the disturbance of the gravel. Fill the tank one-third to one-half full.
5. Add plants and accessories. Fill the tank to within 2 or 3 inches of the top.

How to Fill Your Tank (an alternate method)

Follow instructions 1 and 2 above.

3. Fill the tank one-third to one-half full of water. Put the gravel in a cup or jar. Holding the cup under water, pour the gravel slowly into place in the tank, and shape it with your fingers.
4. Add plants and accessories.
5. To complete the filling, place your hand in the tank so your fingers touch its side and your palm is facing toward you. Pour the water onto the palm of your hand so that it runs down your fingers and onto the walls of the tank without disturbing the gravel.

Locating the aquarium. Put your aquarium in a place where it receives a moderate amount of light. Strong light encourages the growth of algae, which turns the water green. In general, a northern exposure of light is most suitable, although a western exposure is also good. If it is necessary for the tank to face the sun (southern window), fasten a sheet of green cellophane to the portion closest to the window.

If algae turns the water green, you may add quantities of Daphnia, or waterfleas. After the water is cleared, the fish will feed upon the Daphnia. If there are several fish in the tank, you may wish to put some in another tank so the Daphnia won't be eaten before they can clean out the algae.

If sufficient light is not available and plants begin to lose their green color, place an electric lamp with a 75- or 100-watt bulb over the aquarium a few hours a day. Do not keep an aquarium close to a radiator.

Activity: Balanced Aquarium

Program: To set up a nearly balanced tank of fish and plants. (A balanced aquarium is often stated as a desired goal; however, no such thing exists.)

Exhibit: Two fish of different species and a picture of your tank.

Beginner: At least one pair of fish with a simple, appropriate environment (two fish if you are unable to sex them). If you are using guppies, you will need three fish (two females and one male.)

Advanced: Above suggestions with a planned program, definite goals, and a statement of results.

Food

Many varieties of food are available. Carefully look them over, and ask the advice of the clerk when you buy your fish. Some fishes are surface feeders, some eat only from the bottom, some prefer sinking pieces, and others don't care. Perhaps you and your friends would like to buy several kinds and share them. A small packet of food goes a long way. By sharing you can have a variety of food without spending much. Feed goldfish once a day. Tropical fish can be fed two to four times a day. You may feed them up to every 2 hours if you want quick growth, but you *must* keep the feedings small. Be sure they clean up every bit in 5 minutes. Overfeeding is easy and dangerous.

Since goldfish do best in cold, nonheated water, they should not be placed with tropical fish. Most tropical fish require warm, heated water.

Activity: Feeding Experiment (one month)

Use two groups of fish. One group of fish could be fed live food. The second group could be fed regular dried types of food. **Important:** Avoid feeding experiments that deprive the fish of food or that deliberately mistreat the fish. Your fish are living animals.

Activity: Raising Live Food (one month)

Program: To raise live food.

Exhibit: Fish fed on live food and samples of live food.

Choosing Your Fish

If you have an unheated and unaerated bowl, you will have to use care in choosing the variety of fish for your project. Many fishes will do well in this environment, but some will not adapt to the lower temperatures, and others are particularly hard to care for. Remember, the water temperature will be a few degrees lower than the temperature of your home, and if the tank is in a draft, the water temperature will be even cooler. Tanks that are covered and electrically lighted will be several degrees warmer than the room. Water temperature changes more slowly than that of the air. Guppies, which do best at 74–84°F., will survive in 68° water, but they will not breed.

Kinds of fish

Barbs and similar fish:

Cherry Barb, Checker Barb†, Gold Bar*, Pear Danio†, Zebra Danio†, Goldfish†, White Cloud Mountain† (the last two prefer from below 64°–74°F).

Tetras

Neon*, Cardinal, Red-eyed, Black-lined, Buenos Aires†, Tetra† from Rio, similar fish is a Bloodfin†

Livebearers (can be sexed by anal fin-gonopodium — where the anal fin of the male is modified to transfer sperm)

Guppy*, Molly*, Swordtail*, Platy*

Labyrinth Fishes (take extra air at surface)

Betta or Siamese Fighting Fish (keep male in individual bowl), Three-spotted Gourami*†, Blue Gourami†, Opaline Gourami†, Dwarf Gourami

Assorted Families

Peppered Corydoras* (catfish), Egyptian Mouthbreeder, Glass Fish, Australian Rainbow Fish†

Activity: Exhibit

Beginners. Complete record page; identify fish (number, species, sex; food and care record; anatomy picture and type of family if needed). Exhibit a specimen or pair that you have had for at least 4 weeks.

Advanced. Complete record. Keep notebook with program plans, records, and results. Choose and exhibit fish appropriate to program.

Fish Disease. Fungi such as water mold (Saprolegnia) and a protozoan called water itch are two of many parasites that bother fish. Fish with these conditions may show gray patches or scales on their fins and should be isolated quickly. So little is known about many fish diseases that it is usually best to destroy the diseased fish.

You may try immersing the diseased fish in a 10 percent solution of noniodized salt. Remove it after 1 hour and allow it to swim in ordinary water. Usually the patches disappear after this treatment. Put the fish into a 0.5 percent solution of potassium permanganate for 15 minutes. Quarantine the fish in a separate tank, and watch it for a possible recurrence of the condition.

Other symptoms of disease are discovered by watching the behavior of the fish. Watch for the following activities:

- Hiding in the plants,
- Lying on the bottom,
- Holding fins close to their body,
- Gasping for air at the top.

*Fish cared for in a one-gallon bowl.
†Fish that tolerate temperatures as low as 64°F.

Part 2. Examples of Advanced Programs in Breeding

Simple Breeding (3 months)

Program: To start breeding records
Exhibit: Parents and selected young fish

Advanced Breeding (A year or more)

Program: To breed for a specific trait (color or conformation)
Exhibit: Selected young fish

Fish Care Habits

Bowl check. Each time I look, I automatically check—

- Are all fish alive and healthy? Any torn fins?
- Any uneaten food on top or bottom?
- Equipment working properly?
- Temperature? Out of drafts and protected from full midday sunlight?
- Plants healthy and in place?
- Water level up, clear, no foul smell?
- Tank covered? no foreign objects?

General management

- Isolate new or sick fish in a separate small bowl.
- Keep everything but objects known to be safe out of water.
- Turn light off at night and on in the morning (constant light makes fish infertile and may cause algae problems).
- Do not tease fish by splashing water or tapping on the glass. However, goldfish may be trained to come to the side of the bowl by tapping softly.
- See that family members understand the safety rules.

Feeding

- Feed regularly: goldfish once a day, tropicals two times or more if you can.
- Feed no more than they can eat in 5 minutes, remove food promptly.
- Feed fish yourself. In emergency, leave written instructions or have another hobby member do the feeding.
- Give a variety of food.
- Keep food out of reach of others.

Cleaning

- Wash hands before and after caring for fish. Rinse thoroughly before.
- Dump waste water in toilet, *not* in sink.
- Rinse any dishes or pans carefully before using. Don't use metal.
- Wash any dishes or pans thoroughly and put away after use.
- Condition water by aging or with chemicals (well water does not need conditioning).
- Clean the bottom of the tank by siphoning about one-third of the water once a week.
- Replace siphoned and evaporated water with conditioned water.

- Check water temperature before adding it to the tank. Warm the water if necessary by heating a small amount. Add the water by pouring against your palm and down your fingers onto the side of the bowl.
- When changing the water in the entire bowl, save the top one-third to one-half of water if possible to place fish in and add it to the new water later.
- When changing the water in the entire bowl (fish out), use salt (not soap) to clean the bowl.
- Scrape the water evaporation mark off the bowl regularly to prevent an accumulation.
- Use a scrap of nylon net to clean the sides of the bowl.
- Keep all chemicals on a high shelf. They will kill fish if they are not used according to the instructions on the container.
- Never touch fish with your hands; use a net.

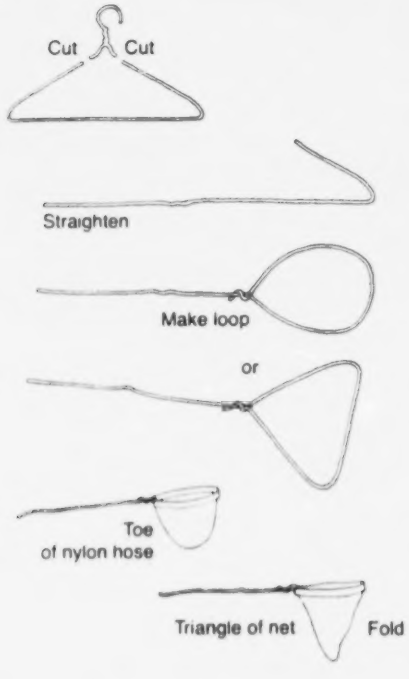
Safety Rules (For your family and friends)

Fish need specific kinds of care. Do not leave small children alone with fish until you have supervised their first viewings and have carefully explained that they should not try to care for or play with the fish. Anyone who does not know how to care for fish should not:

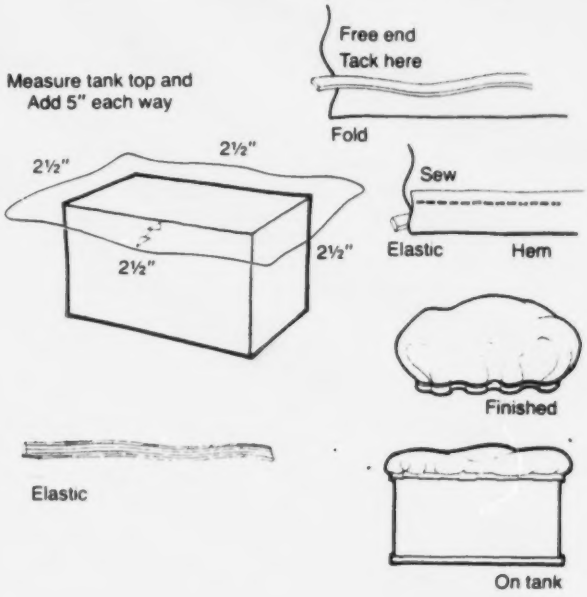
- put anything in the water,
- feed fish,
- tap on the glass or splash the water,
- touch the equipment, or
- try to catch fish.

Simple Equipment to Make Yourself

Net. Wire clothes hanger, ladies nylon stockings (without holes or a run in the toe), tape or file, needle and thread, pliers with wire cutter or both pliers and wire cutter. Cut hanger as shown. Straighten. Bend short end into loop and twist around handle. Smooth rough edges with file or cover with tape. Cut about 3½ inches from toe of hose, and sew onto loop of wire. You could instead use a small piece of nylon net.



Tank cover. Piece of nylon net, narrow elastic, needle, and thread. Cut nylon net 5 inches wider and 5 inches longer than tank measurements. Cut elastic long enough to reach around tank. Leaving 1 inch of elastic free, tack it firmly to net, fold net over elastic, and sew a casing for it. Pull end of elastic forward as you sew, gathering net. Elastic must pull freely through casing except where one end is tacked. When you have sewn around all four edges of net, overlap the end of the elastic (1 inch free at beginning), and sew it firmly.



Bowl cover. For round top you may use a square of net and secure it with a large rubber band.

Siphon. For small jobs, use two large plastic straws and masking or freezer tape. Pinch end of first straw slightly to insert into second straw. Tape securely to make airtight. Dampen finger and place over upper end while lowering straw into water. Remove finger and replace immediately. This sucks any dirt just below straw into straw. Keep finger firmly over end while removing dirty water to a waste jar. Remove finger to let dirt run into jar.

For large jobs, measure tank from bottom to top; then measure from top of tank to floor, and add about 6 inches. Find or buy a piece of plastic tubing this long. Get a gallon jar to put the dirty water in.

Fish bowls. A single fish may be isolated in a clean, wide-mouth quart jar such as those mayonnaise and peanut butter come in. Cover and keep water level down 2 inches from top. You can make a bowl for many baby fish or up to six small fish. Ask a restaurant or drive-in to save you the kind of 1-gallon jar that pickles, mayonnaise, or mustard comes in. Clean carefully and rinse with salt water; then rinse several times with clear water. Fill jar to about 3 inches from the top, and cover it with a net, never a solid lid.

To transport fish or introduce them to water of a slightly different temperature, use a heavy-gauge plastic bag. Test the bag first to make sure it is watertight. Fill it half full of water and fish (at least a pint of water), and close it with a rubber band. Carry the bag in a large purse, cardboard container, or styrofoam box to protect the fish from chills or overheating and jolts that might rupture the bag. Do not leave the fish in the bag any longer than necessary. To introduce the fish into different water, hang the bag in the new water for at least 15 minutes; then rupture the side of the bag carefully to let the fish swim free.

Preparing Fish for Exhibit

- If you have several fish, choose large, healthy specimens.
- Carry the fish to the show in a small bowl with a plastic cover. Put the bowl in a box and hold it firmly in place by putting foam rubber or tightly wadded paper around it. This will protect it from spilling and minimize temperature changes.
- In certain cases when you cannot exhibit your project fish, you may get permission to buy one and be judged on choice of suitable fish. Examples of acceptable reasons are: (1) livebearer female close to term (guppies are fairly hardy, but mollies often lose their babies if moved); and (2) fish died from cause other than neglect. Get permission of leader and parent. Include explanation with exhibit.

Example: *I am not able to exhibit my project fish because...*
I chose the alternate fish for these reasons...
(note desirable characteristics)

Name _____

Part III. Specialized Aquariums

Native (Freshwater) Aquarium

One interesting and inexpensive experiment is to set up a native aquarium containing materials and animals from streams and ponds in your own locality.

A small rectangular tank will do. You might even use one of the all-glass, flat-sided aquariums that can be purchased for several dollars in a discount or department store. Even a gallon wide-mouthed jar (although restricted in its uses) will do for a small start.

Put sand in the bottom of the container, and plant whatever you have collected. Don't put fish in for several weeks; wait to see what develops without them. Some interesting things can happen.

The next step will be to put some fish in, preferably from the same source as plants. If they come from a fast-moving stream, you should introduce some aeration. If they are from a small, still pond, aeration may not be necessary.

Keep a careful record of your progress with the project.

Marine (Saltwater) Aquarium

A marine aquarium is a complicated project that is not for the beginner to try. It requires, among other things, a careful control of salinity in the water. For this, a hydrometer is necessary. One must also have a tank in which metal surfaces do not contact the water.

Anyone living near the sea, however, has a chance for maintaining an excellent marine tank. Some of the most beautiful fish are marine inhabitants. The tank must be rather large (5 gallons per fish) and free of corrosive materials. Some cements are dissolved by salt action.

Carefully record your work and results.

Notes for Leaders

The activity sheet on fish aquariums contains all the information needed to carry out this project. The leader should stress observation skills above all else. By observing a fish aquarium, you can see many behavioral displays, food chains, and environmental relationships.

The members' guide is broken down into sections that can be covered in one meeting. But you should judge for yourself if more time is needed to cover the material in each section.

Encourage each member to use record sheets for systematic observations of life in the aquarium.

If further help is needed, section 597.074 of your library has books on aquariums and fish. Local aquarium and pet stores may also be of assistance.

Part I. The Balanced Aquarium

Equipment. Use a loose-leaf notebook to keep records of the equipment used in the project. Whenever possible, have the members describe the equipment and how it is used. Diagrams can be drawn to illustrate special conditions.

Because aquarium equipment is expensive and needs proper care, members could keep a ledger of the purchase and maintenance costs of the equipment. They can also estimate the cost (based on wattage) of energy needed to heat the aquarium and run the pump.

Costs should be recorded for the entire project and broken down for each aquarium.

Environment. Because different fishes require different environments, a record of conditions affecting the fish can be kept. This record might include water condition, depth, temperature, acidity, hardness, or materials used in the aquarium. Plants and their uses can also be observed. A diagram showing the location of plants in the tank can be drawn, and observations of the reaction of the fish to the plants can be made.

Foods. Fish depend on the proper foods to keep healthy. A record can be kept of the kinds of food used and the results obtained from them.

Some fishes eat nothing but dry frozen food. Scraps from the kitchen, worms raised in the basement, or foods gathered from nature can also be used. One meeting might be spent collecting food, such as Daphnia and Tubifex worms from ponds or streams near where you live. But be careful not to introduce anything harmful into the aquarium.

The fish. Have members keep a record of the different kinds of fishes acquired for the aquarium project. Include the common name, scientific name, date introduced, cost, and general comments. Drawings can be done of the fish to note identifying characteristics.

Part II. Breeding

Breeding habits vary greatly from one species to the next, and observations and records can be made to distinguish different breeding patterns. Which fishes bear live young? Which lay eggs on sand, plants, or in the water? Do all species breed in captivity? Record of the care given to fish during breeding can also be made.

Another project that members might undertake is the study of fish behavior. Observe traits such as territoriality and schooling. Why do fish behave in these ways?

Diseases, pests, and problems. Aquatic animals, like all other living things, can be affected by diseases and other threatening conditions. Quick identification and remedy of such problems are important.

Have members record symptoms of illness and steps to correct the problem. Encourage them to be aware of disease and other enemies and careful not to introduce them into the aquariums.

Some fish are going to die. Keep a record of the deaths to prevent future losses.

Experimenting. Because aquariums are fascinating laboratories for studying fish, members can conduct experiments using the following steps:

- Purpose — Tell what you hope to learn.
- Procedures — Describe what you are going to do.
- Observations — What happened as a result of what you did?
- Conclusions — What did you learn because of your observation?

The author of this activity is H. David Greene, regional extension specialist, East Aurora, New York.

Some ideas and portions of this sheet used by permission or adapted from the 4-H Aquatic Science project, Worcester County, Maryland Extension Service, the University of Maryland cooperating, and *Aquatic Science — Fish Culture* by James T. Davis, extension fisheries specialist, the Texas A&M University System.

For additional copies and information contact:

Youth Coastal Education Program
21 South Grove Street
East Aurora, NY 14052

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The State University of New York and Cornell University cooperatively carry out the Sea Grant Program using their own funds as well as State and Federal appropriations. Nearly two-thirds of the dollars come through the National Sea Grant office of the National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

This publication is issued to further Cooperative Extension work mandated by acts of Congress of May 8 and June 30, 1914. It was produced with the cooperation of the U.S. Department of Agriculture and Cornell Cooperative Extension, College of Agriculture and Life Sciences, College of Human Ecology, and College of Veterinary Medicine, at Cornell University. Cornell Cooperative Extension provides equal program and employment opportunities. Lucinda A. Noble, Director.

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A Saltwater World in a Jar

Aquatic Activities for Youth — 7

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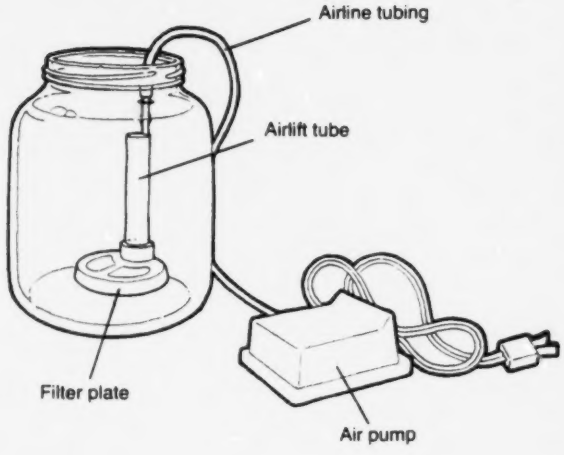
You can easily make an inexpensive saltwater aquarium out of a gallon jar. You also need a goldfish bowl filter, a small air pump, some oyster shells, and salt water. You can either collect your aquarium critters on a field trip to the shore or, if you live inland, you can buy special saltwater species at a local pet shop. Be sure that any fish or invertebrates (animals without backbones like shrimp, sea anemones, and shellfish) that you buy are from temperate, not tropical waters. Tropical animals have special temperature requirements. Fresh fish markets are sometimes a good source of crabs and snails for your aquarium.



The Container

Wide-mouthed (4.5 inches, 11.4 cm) 1-gallon glass jars can often be obtained from the school cafeteria or a local restaurant. Many hot dog stands get mustard and ketchup in large jars and would be willing to give you one. Clean the jar carefully, but don't use any soap. No matter how hard you try, you'll never get all the soap out. If you must, you can use either baking soda or salt to make the jar as clean as possible.

Location

Select a site on a sturdy table or countertop away from radiators and direct sunlight. If the location is too sunny, algae will grow on the walls of your tank. The cooler the location, the better. Saltwater fish like cool water. Remember: fish breathe the oxygen dissolved in the water, and cool water can hold more oxygen than hot water. The fish remove the oxygen by taking water into their mouths and then passing it through their gills.

The Water

You can either use natural seawater for your aquarium or eliminate the problems of hauling water from the shore by using one of the synthetic sea salts that are available in pet stores. Seawater contains many types of salts in a delicate balance, so don't try to improvise with table salt (sodium chloride).

If you want to collect your own seawater, carry it in a plastic pail lined with a plastic trash bag. When the pail is full, simply close the top of the bag with a twist tie to keep the water from sloshing. One gallon of water weighs over 8 pounds, so don't fill the pail with more water than you can lift. Try to collect your water as far out from the shore as possible, because water near the shore tends to be more polluted.

Fill the gallon jar only to its widest point. This will allow the maximum exchange between air and water and thus provide the best aeration.

If you use synthetic salts, follow the directions on the package. These synthetic salts do not contain the microscopic life and organic material essential to a healthy aquarium. To provide these materials, you should have a 2-week run-in period when the only tenant in your tank is a crab. Marine organisms produce ammonia as a waste product. In the open ocean, the poisonous ammonia is harmless because it is diluted by the great amount of water. In a small tank, ammonia can build up and kill the organisms. Crabs, which are extremely resistant to this buildup, can survive where other organisms would die. You can also start a new tank simply by seeding it with some gravel from another older tank that has already built up a population of bacteria.

Filtration and Aeration

Because salt water tends to hold less oxygen than fresh water, a saltwater aquarium must have a good source of oxygen. Oxygen not only allows the fish to breathe, but also allows for the buildup of aerobic (oxygen-using) bacteria, which break down poisonous waste materials in the tank. Without these friendly bac-

teria, your tank would quickly poison itself. One type of bacteria, *Nitrosomas*, breaks the ammonia down into nitrites. A second type of bacteria known as *Nitrobacter* changes the nitrites to harmless nitrates. Most marine animals are relatively tolerant to the buildup of nitrates, but the level should be reduced by changing about one-fifth of the water every 2 weeks.

For filtration and aeration, use a goldfish bowl filter, which fits neatly into a 1-gallon jar. This type of undergravel filter works as a biological filter system. The air pump forces air bubbles into the water. This air–water mixture is lighter than the plain water in the jar. The lighter air–water mixture rises to the top and forces the plain water down through the filter. Large waste particles are trapped by the gravel as the water passes through.

If your tank includes clams, mussels, barnacles, or sea anemones, avoid a system that filters all materials from the water. These animals are natural filters and will starve to death if the filter in your tank is too effective.

Substrate

Substrate is the material that covers the bottom of the tank. A good substrate for a marine tank is dolomitic limestone, which is available at a pet store, or crushed oyster shells which you can make yourself. If you are going to crush your own oyster shells, put the shells between a few sheets of newspaper and crush them with a hammer. The newspaper will make it easy to clean up, and, more importantly, it will prevent any pieces of shell from flying up into your eyes. Don't hit them too hard because you want to get pieces that are too large to fit through the openings in the filter. Also, there must be space for water under the filter. If the crushed particles are too small, you can cover the filter plate with a nylon stocking to reduce the size of the openings.

Before putting the gravel into the tank, rinse it with tap water until the runoff is clear. The layer of substrate should be about 2 inches deep. Most people have poor success trying to maintain marine plants, so you're better off without these. However, you should provide some plastic plants to provide hiding places for the animals.

Temperature

The best temperature is similar to that of the animal's natural habitat. It is usually lower than room temperature. Don't put your tank too close to a light because it may raise the temperature of the water. Adding an ice cube to the tank every morning keeps the temperature down and makes up for water lost by evaporation. When the water evaporates, salt is left behind, and the saltiness of the water increases. Test it yourself: put some salt water into a dish and place it on a sunny windowsill. What do you find after the water has evaporated?

Remember that warm water holds less oxygen than cold water. Again, run your own test: make two trays of ice cubes, but use hot water for one and cold water for the other. When the water has frozen, examine both types of ice cube. How do they differ? Why are the cubes made with cold water cloudier than those made with hot water?

Most marine organisms tolerate a temperature range from 40–70°F and can tolerate *gradual* temperature changes.

pH Level

Scientists use the abbreviation *pH* to tell how acidic or basic something is. Vinegar and lemon juice are examples of acids. Baking soda and ammonia are examples of bases. The pH scale runs from 0 to 14. Water with a pH of 7.0 is neutral. As the pH drops below 7, we say the substance is acidic. The lower the number, the more acidic it is. As it rises above 7, it becomes increasingly basic. If a chemical has a pH of 13, is it an acid or a base? What if it has a pH of 3?

The pH of the water in your tank should range from 7.5 to 8.3. As the water in the tank ages, though, it has a tendency to become more acidic. The dolomitic limestone or crushed oyster shell that you used as a substrate is important in maintaining the proper pH of your tank. It provides what scientists call a *buffer*. A buffer is a chemical that helps to keep the pH constant.

If you find that the pH of your tank is dropping, add a small piece of chalk or a little baking soda. Both of these substances are buffers. You can test the water by using pH paper or a pH test kit obtained from your science teacher.

Density – Salinity

The density of something is how much a certain amount of that substance weighs. Lead would have a high density because a cube that measures 1 inch on each side would be heavy; cotton would have a low density because a cube that measures 1 inch on each side would be light.

A *hydrometer* is a device used to measure density. It is a glass tube weighted at the bottom so that it floats at a certain level in the water. Density becomes greater with increased saltiness. The saltier the water, the higher the hydrometer will float. The numbers on the hydrometer scale run from 1.000 to 1.025.

Before reading the hydrometer, unplug the air pump to calm the surface of the water. Density is also affected by temperature. Use the chart below to find the appropriate density of seawater at each temperature.

If the water is too salty (that is, if the hydrometer reading is higher than the number on the chart), add fresh water until the hydrometer floats at the correct level.

Temperature	Density
60°	1.0240–1.0245
65°	1.0235–1.0240
70°	1.0230–1.0235
75°	1.0225–1.0230
80°	1.0220–1.0225

Feeding

Most marine animals thrive on a diet of frozen fish or clams. Overfeeding can be a major problem. The animals should be able to clean up all their food in about 5 minutes. Remove any leftovers before they foul the tank. They can be removed with a turkey baster, which is less expensive than an aquarium vacuum.

General Maintenance

A gallon jar aquarium can generally support two or three animals, depending upon their size. If any of the animals looks sick, remove it immediately to a "hospital tank." If you keep hermit crabs, provide some larger shells so the animals can move when they become cramped.

Algae can be carefully scraped off the walls of the tank with a single-edged razor blade and sucked out with the kitchen baster.

Cloudy water generally indicates an unwanted growth of bacteria. The best thing to do in this case is to start the tank over again with new water.

Tank water can easily become poisoned. Make sure that no metal ever comes in contact with the water. If you suspect that the tank has been poisoned, dilute the poison by changing about half of the water immediately.

Keep a daily log of your tank. Record information about pH, temperature, salinity, and any changes that you observe in the animals.

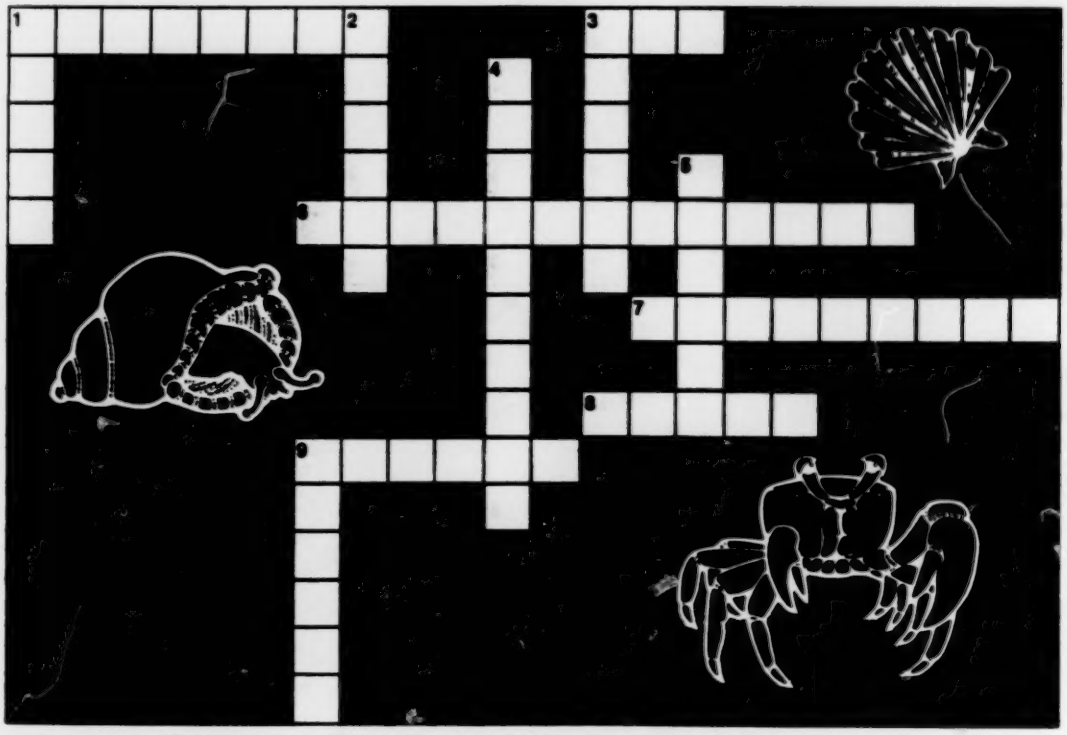
LOG	Temperature	pH	Salinity	Animal condition
Oct. 1	75°	7.5	1.0225	
Oct. 2	80°	7.5	1.0220	
Oct. 3	80°	7.7	1.0225	Herman the hermit crab moved to a larger shell
Oct. 4	70°	8.0	1.0230	

Across

1. Tank in which we put plants and fish
3. Body part that allows a fish to move
6. Animals without backbones
7. When water changes to vapor
8. Body part that a fish uses to breathe
9. What fish breathe

Down

1. Plant growth on sides of tank
2. Term meaning salt water
3. Device that cleans aquarium water
4. Device to measure density
5. Aquarium substrate
9. Animal that makes pearls



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Notes for Leaders

One advantage to using gallon jars for aquariums is that one large air pump can supply several jars, and teams of students can maintain their own aquariums. With a series of gang valves, you can run 10 gallon jars off of one large, silent-type air pump. Although this type of pump is relatively expensive (about $20.00), it tends to last a long time, runs quietly, and can aerate a large quantity of water.

Sometimes individuals are willing to donate fish tanks and equipment to schools. Teachers might find tanks by placing ads in local newspapers. With a letter on school stationery to acknowledge the contribution, the donor can take a tax deduction, and the teacher gets a free aquarium.

When selecting a site for your tank, remember that incandescent lights produce heat; fluorescent lights don't. A fluorescent lamp will stimulate the growth of algae on the walls of the tank without increasing the temperature. The algae can then be scraped off and studied under the microscope.

Volatile substances dissolve quickly in salt water. Fumes from paint and proximity to animals such as hamsters or mice can kill your marine animals. The waste products from these mammals dissolve in the air and subsequently find their way into your aquarium.

Related Activities

- Raising brine shrimp
- Maintaining records and graphs
- Observation
- Using keys
- Word puzzles
- Math problems
- Reading temperature scales
- Using the metric system
- Measuring
- Constructing collecting equipment
- Photosynthesis and plant pigments
- Testing pH
- Investigating properties of water
- Research and writing compositions
- Reading maps

This unit was produced by:
Linda J. O'Dierno
New York Sea Grant

and edited by:
Leslie Ware
New York Sea Grant

Glossary

Aerobic — Requiring oxygen
Bacteria — Microscopic organisms, some of which are useful to human beings and some harmful
Density — The weight of a certain amount of a substance
Evaporation — When water changes from a liquid to a gas
Habitat — Place where a plant or animal lives and grows
Hydrometer — Device to measure density or salinity
Invertebrates — Animals without backbones, like crabs and clams
Nitrobacter — Type of bacteria that changes nitrites into harmless nitrates
Nitrosomas — Type of bacteria that changes ammonia into nitrites
Salinity — How salty something is
Toxic — Poisonous

Further Reading

Axelrod, Herbert R. and Will Vorderwinkler. *Saltwater Aquarium Fish.* T.F.H. Publications, Jersey City, New Jersey, 1967.

Spotte, Stephen H. *Fish and Invertebrate Culture: Water Management in Enclosed Systems.* Wiley-Interscience, New York, 1970.

Straughan, Robert P. L. 4th rev. ed. *The Saltwater Aquarium in the Home.* A. S. Barnes and Company, Cranbury, New Jersey, 1975.

Waters, Barbara and Waters, John. *Salt Water Aquariums.* Holiday House, 1967.

Answers to crossword puzzle:
Across: 1. *aquarium;* 3. *fin;* 6. *invertebrates;* 7. *evaporate;* 8. *gills;* 9. *oxygen.*
Down: 1. *algae;* 2. *marine;* 3. *filter;* 4. *hydrometer;* 5. *gravel;* 9. *oyster.*

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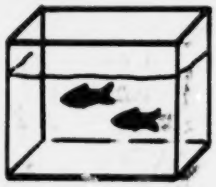
WILDLIFE PROJECT

Making a Fresh Water Aquarium



Introduction

Making an aquarium can be fun. You can make your aquarium as simple or complex as you want to. It can be made to resemble a pond, lake, or marsh. Remember, you are in control. There are two main kinds of aquaria. One is made using freshwater and the other is made using saltwater.

Balance is important in an aquarium. You can alter the balance of either the plants or fish in an aquarium and see dramatic changes take place.

Aquaria come in all sizes and shapes. A rectangular one is probably the best shape. One rule to remember is that the width should equal the height. This allows for a greater surface area of water. The amount of surface area of water controls oxygen transfer from the atmosphere. So within limits, the greater the surface area the greater the oxygen transfer.

Setting Up the Freshwater Aquarium

The number of freshwater animals and plants that will thrive together in an aquarium depends on the amount of water it will hold.

Keeping the water clear and clean is important. Do not use mud for the bed. Use coarse, clean sand. The coarser the better. Fine sand entraps decaying organic material. When you have cleaned the coarse sand, place a layer on the bottom to a depth of approximately one inch.

The next step will be to collect some stones. Here you will have to use your judgment on the size and number of stones that you collect. The stones will be used for:

a. landscaping
b. anchoring plants in the sand
c. to provide shelter for water creatures
d. to increase the amount of surface area in the aquarium for water creatures to crawl and climb on

Use your imagination in selecting stones of different shapes and sizes. Make sure that they have a flat side so they will not tip over once you place them in the aquarium.

Decide where you want to keep the aquarium before you fill it with water. Moving the aquarium once it is filled with water could cause a leak. Moving can also result in damage to your landscape in the aquarium. Choose a location with a lot of light. Be careful not to place your aquarium in direct sunlight. Direct sunlight can cause overheating of the water. Overheating will reduce the amount of oxygen in the water and some of your fish may die. Direct sunlight can also cause the green plants to grow too rapidly. Try to keep the temperature of the room between 60 and 70 degrees if possible.

Now that you have selected a location for your aquarium, you are ready to add the water. The water that you use in your aquarium is important. All life is dependent upon it. It must be clean and free of impurities. Water from the tap is probably your best source. Draw enough *hot* water in a separate container to fill the aquarium. Be sure to let it cool to room temperature before you pour it in the aquarium. Tiny bubbles will escape while the water is cooling. These bubbles will remove some of the contaminants that might cause injury to your fish.

Do not boil the water. Boiling removes oxygen. Boiling can also concentrate some chemicals that influence hardness and salinity.

Be careful not to disturb the sand and gravel when you add the water. Pour in the water slowly on a flat rock or a tin jar lid (deep side up). Cover the bottom of the aquarium to a depth of about two inches.

Now you are ready to select the plants for your aquarium. The number and kind of plants that you select will, in part, be determined by the size of your aquarium. A field trip to collect plants can be a lot of fun. Some plants that grow in ponds and slow moving streams that you might want to consider are:

duckweed	water crowfoot
american pondweed	water star wort
hornwort	sweet flag
water lily	varied-leaved pondweed

Be sure that when you put your plants in the aquarium you bury the roots in the sand. In addition to the plants, make several rock piles on the bottom of the aquarium. Pile the rocks loosely. This will pro-

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vide hiding places for some of your animals. Now pour in the rest of the water. Do it gently so you do not disturb any of your arrangements.

Now you are ready to add animal life to your aquarium. Ponds, streams, and creeks are full of animal life that you can use in an aquarium. Make a collecting trip to a nearby pond or stream. Some of the creatures that you might want to use in your aquarium are:

pond skates	freshwater shrimp
backswimmers	female cyclops
whirligig beetles	water flea
tadpoles	flatworm
water snails	blood worm
water scorpion	golden shiner
darter	gambusia

Managing a Freshwater Aquarium

Your ability to manage an aquarium will depend on your knowledge of certain rules by which animals and plants grow and live. Plants are an important part of the world of your aquarium. They manufacture their own food. They do this using water, carbon dioxide and chemicals dissolved in the water. They can

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only do this in the presence of a good source of indirect light. During the process of food making, oxygen is given off by the plants. This oxygen is used by many water creatures. In return, the water creatures release carbon dioxide into the water. This replaces the carbon dioxide used by the plants.

Under some conditions the oxygen supply for aquatic animals such as fish becomes low. When this happens, they begin to skim the surface. Now you must find the cause of the low oxygen supply. Is it from high water temperature? Too many fish inhaling the limited supply? Too few green plants producing oxygen?

Another problem you may face is your plants growing out of control. Maybe you may want to add some animals that feed on plants. You can even crop some of the plants yourself.

A very common problem is overfeeding. Feed your aquatic animals at regular intervals. Do not feed them too much. When food begins to collect at the bottom of the aquarium, you are overfeeding.

SOME OTHER THINGS TO DO

1. Be alert for new additions for your aquarium.

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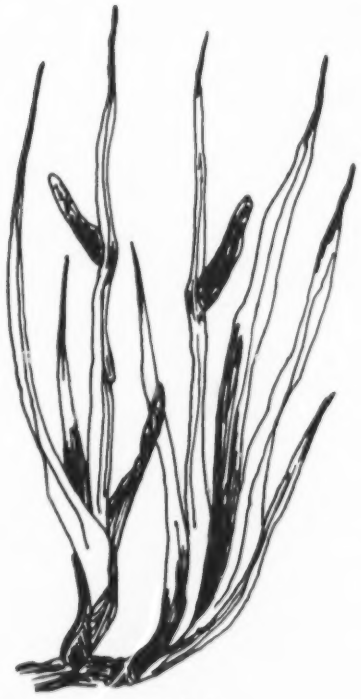

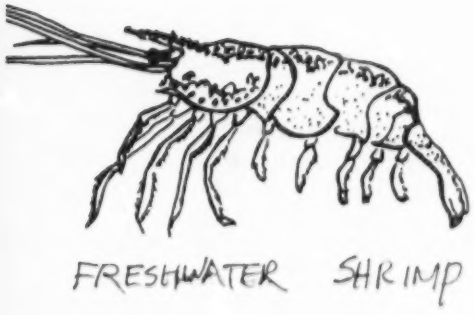

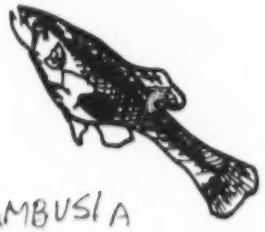

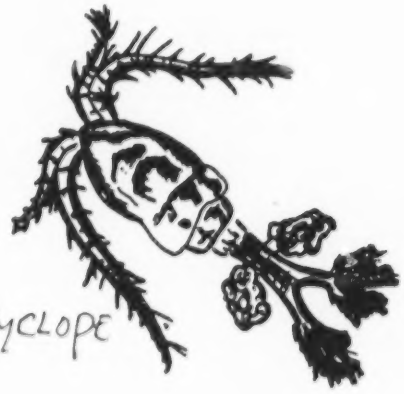

2. Give a demonstration to your club on how to build an aquarium.
3. Give a demonstration to your club on how to collect plants and animal creatures for an aquarium.
4. Give a demonstration on life cycles and food chains that you have observed in your aquarium.

Check with your local library for additional information. Several good sources are:

Furneaux, F. 1935. Life in Ponds and Streams. Longmans, Green and Co., New York. (Gives information on ways to set up and maintain the freshwater aquarium.)

Needham, J. G. and P. R. Needham. 1962. A Guide to the Study of Freshwater Biology. Holden-Day Inc. (This book gives ways to collect and identify all forms of freshwater forms of life.)

Reid, G. 1967. Pond Life. Golden Press, New York. (Good inexpensive guide to plant and animal creatures found in ponds and streams.)

Reynolds, C. 1965. The Pond on My Windowsill. (Gives information on how to make freshwater aquarium.)

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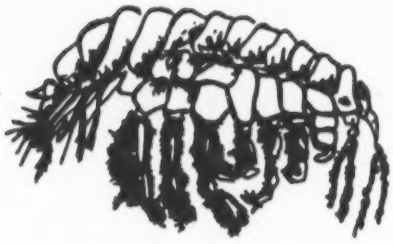
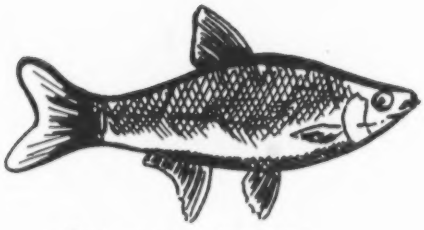


WATER FLEA



GOLDEN SHINER

TADPOLE

ACKNOWLEDGEMENTS

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Entomology and Water

Aquatic Activities for Youth — 3

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The water habitat provides an excellent laboratory and collection point for the study of insects. A good understanding of insects can help to make a successful fly-tying fisherman, and a good understanding of water can make for a successful insect-gathering trip.

For those who want to find many insects with relative ease, this guide should help.

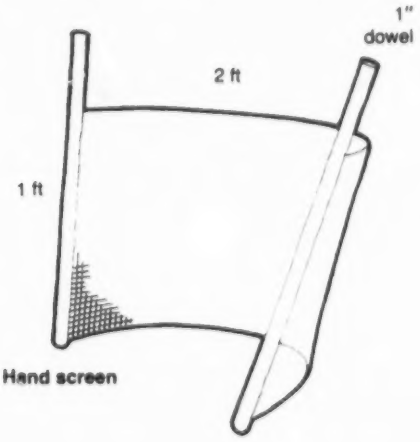
Equipment

Personal equipment:

- Clothing suitable for water including boots, waders, and other waterproof gear.
- A white-bottomed pan for sifting materials (old refrigerator trays are excellent, and plastic bleach bottles cut in half work well).
- A pocket lens, tweezers, insect field quide, and collecting bottles (old baby food jars are good).

Additional collectors:

- A 1 × 2-foot handscreen that can be made from wire door screening and 1-inch dowel rods. It is held in the current by one person while another turns stones and dislodges materials on the upstream side.



Hand screen

- Dip nets for use in ponds.
- Kitchen strainers with long handles for sifting through materials.
- Sand sieve.

Making a Sand Sieve

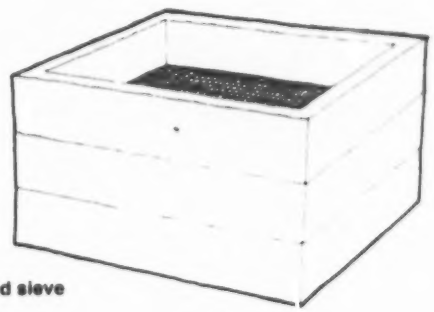
Many aquatic organisms burrow in the mud. A handy way to find them is by using a sieve.

Materials

- light wood crate
- nylon window screen
- nails

Method

- Take a screw driver or claw hammer and pry the bottom of the crate off.
- Measure and draw a line halfway up on the inside of the crate.
- Cut the screen so that it is 3 or 4 inches wider and longer than the inside of the crate.
- Nail the screen along the line drawn inside of the crate.
- Your sieve is now ready for use.



Sand sieve

Where to Look for Organisms

Since water provides the home for the immature stages of many adult insects, a collecting trip along the banks of a pond and stream will provide success for the young entomologist. Riffles are the areas in streams that provide the most insects. Here, the oxygen content is high because the water washes over rocks. Insects can also be found in the mud on the bottom of the pond or stream. Look under rocks, too, because they provide shelter for many organisms of interest. Insects can also be sorted from bottom sediments the same way they are sorted from "trash" on the forest floor.

What Will Be Found

The larvae of many of the Diptera (flies) and Coleoptera (beetles) can be found, as well as the nymphs and larvae of such orders of insects as mayflies, stoneflies, dragonflies, dobsonflies, and caddisflies. The observant person can find several stages of insect growth in a relatively small area and will gain a concept of the food web in streams.

Once the insects are collected, preservation and display techniques for the project are the same as those for the 4-H entomology project, which is available at your local extension 4-H office.

The author of this activity is H. David Greene, regional extension specialist, East Aurora, New York.

The author would like to thank Linda O'Dierno for her help in the writing of this activity.

For additional copies and information contact:

Youth Coastal Education Program
21 South Grove Street
East Aurora, NY 14052

What is Sea Grant?

Sea Grant is a state and federal program concerned with the understanding, development, and wise use of our ocean's resources. The Sea Grant Extension Service is the link between researchers' and scholars' knowledge of the ocean and the practical application and use of such information. Sea Grant Extension Service has local offices on both of New York's coastlines. Extension specialists assist a variety of marine users and potential users, including commercial and recreational fishermen, elementary and secondary school teachers, shorefront community leaders, and officials. For more information about Sea Grant marine education programs and how you can participate, contact:

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The State University of New York and Cornell University cooperatively carry out the Sea Grant Program using their own funds as well as State and Federal appropriations. Nearly two-thirds of the dollars come through the National Sea Grant office of the National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

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